RP

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February 14, 1990
RP:0121

Mr. Manabu Tagomori
Deputy Director
Commission on Water Resource Management
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawai'i 96817

Dear Mr. Tagomori:

Application for a Stream Channel Alteration Permit
Nu'uanu Stream
Honolulu, O'ahu (TMK: 2-2-36:61)

We thank you for the opportunity to comment on this document. Our review was prepared with the assistance of Paul Ekern, Hydrology; and Robert Irwin, Environmental Center.

A storm flood retaining wall is being undercut by stream bed erosion. The applicant's proposed mitigation measure is to create a loosely anchored debris slope by dredging and bulldozing the stream bed. The resultant structure is not likely to be a long-term solution to the current erosion problem. Flood flows can be expected, eventually, to disperse such an arrangement of moved earth.

Dr. Ekern has suggested a more stable structural alternative: an ordered assembly of small boulders placed in "gabions" and fitted to form a toe at the foot of the extant wall. We forward a copy of the journal materials which he has provided which explain and illustrate this more effective alternative approach.

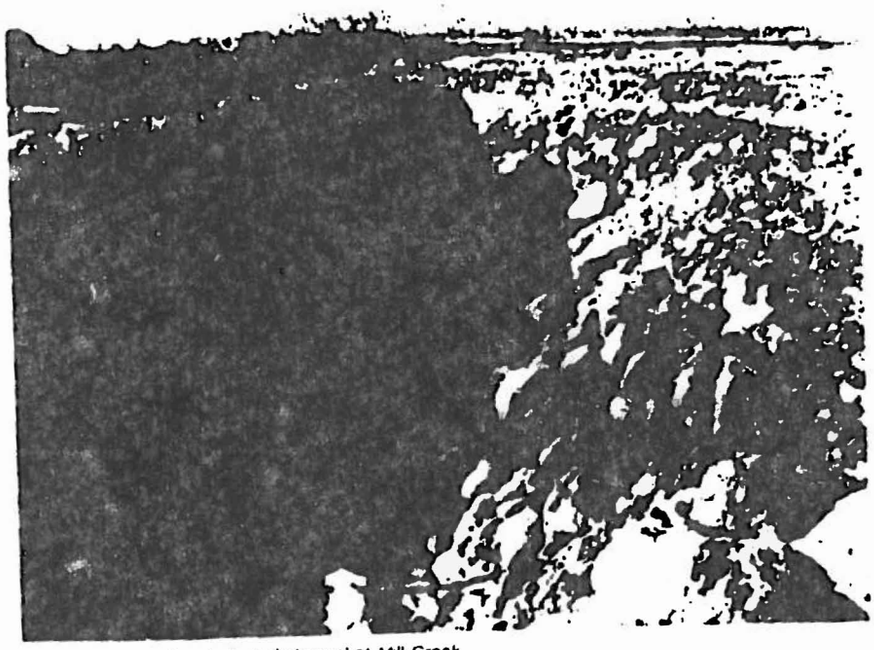
It is in the interest of the applicant's clients that the most permanent and cost-effective solution be implemented.

Thank you, once again, for this opportunity to have commented.

Yours truly,

John T. Harrison
Environmental Coordinator

cc: OEQC
L. Stephen Lau
Paul Ekern
Robert Kai Irwin



Gabion directional groin in mid-channel at Mill Creek

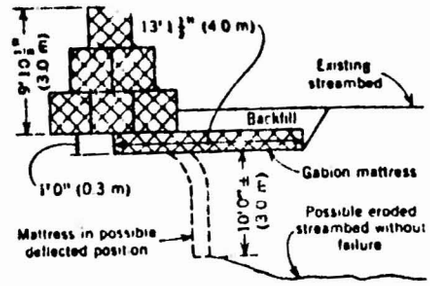


Fig. 1 Typical gabion barrier

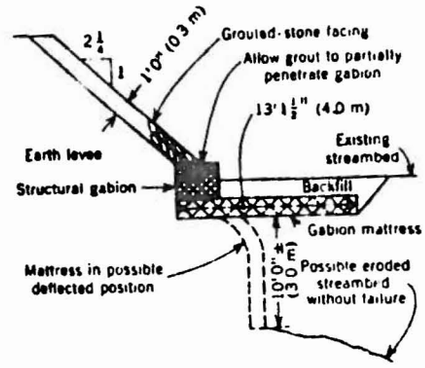


Fig. 2 Gabion toe protection for a stone-faced levee.

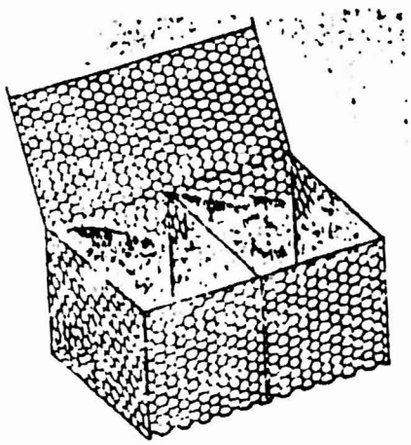


Fig. 1. Gabions are supplied flat and must be assembled by folding and wiring the edges together. The baskets are filled with stone to a depth of 1 ft and an internal wire connected to both sides. This operation is repeated (1 ft of stone, wire, 1 ft of stone, etc.) until baskets are filled. Then adjoining gabions are wired together by vertical edges and the next row of empty gabions are wired to the filled ones.

1 June 1974

The principle of Reinforced Earth

Reinforced Earth is a composite material formed by associating earth and reinforcements in about the same manner as concrete is reinforced with steel to form reinforced concrete. In both cases, reinforcements are used in the direction of the greatest stresses, to resist tension in the matrix material.

In Reinforced Earth structures, the thin metal reinforcing strips are laid horizontally within the earth mass and attached to the vertical facing panels which are, most commonly, precast concrete.

The basic mechanism of Reinforced Earth is the *friction* between the earth backfill and the strips. Friction without slippage is possible if the earth has certain minimum frictional characteristics—a minimum 25° angle of internal friction and no more than 15° passing the No. 200 sieve.

Tensile forces are absorbed by the reinforcing strips which, in length, are usually 0.8 to 1.2 times the height of the structure. With proper vertical and horizontal spacing and length as specified by The Reinforced Earth Co., the fill volume is internally stable between each layer of strips. The facing panels are employed to anchor the strips and to retain the fill volume at the end of the strips.

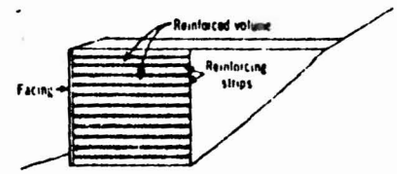


Fig. 1. Reinforced earth structure.